Installation Manual

SolarBOS ReCombiners
Disconnect Enclosures
Contactor Enclosures
& Fuse Boxes

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Revision History

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1.0	23 Nov 2011	CS	Preliminary Release
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1.2	14 June 2012	WC	Enclosure Update
1.3	14 March 2014	WC	Torque Values

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1.0 IMPORTANT SAFETY INSTRUCTIONS
SAVE THESE INSTRUCTIONS

This manual contains important instructions for all SolarBOS recombiner models that must be followed during the installation and use of recombiner boxes.

These recombiners are designed and tested according to international safety requirements, but as with all electrical and electronic equipment, certain precautions must be observed when installing the recombiners. To reduce the risk of personal injury and to ensure the safe installation and operation of the recombiners, you must carefully read and follow all instructions and warnings in this *Installation Guide*.

Safety and Hazard Symbols

This symbol appears beside instructions and warnings that deal with dangerous voltages that can injure people who come in contact with them.

Warnings

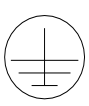
WARNING: A warning describes a hazard to equipment or personnel. It calls attention to a procedure or practice, which, if not correctly performed or adhered to, could result in damage to or destruction of part or all of the SolarBOS equipment and/or other equipment connected to the SolarBOS equipment or personal injury.

Warnings may also be accompanied by one or more of the safety and hazard symbols described above to indicate the type of hazard described therein.

Other Symbols

In addition to the safety and hazard symbols described previously, the following symbol is also used in the *Installation Guide*:

This symbol accompanies notes that call attention to supplementary information that you should know to ensure optimal operation of the system.



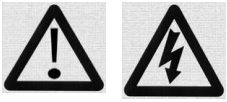
This GROUND symbol marks areas in the recombiner box for connecting equipment grounds only.

1.1 Warranty

All recombiners sold in the USA have a five-year warranty. For warranty coverage, or if you have questions about the recombiner box warranty, contact SolarBOS at the address, telephone number, or Web Site listed on page 1 (to send e-mail, see the Contact section of the SolarBOS Web Site: www.solarbos.com).

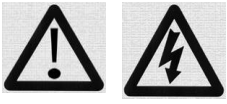
1.2 Warnings

WARNING: All electrical installation must be done in accordance with the National Electrical Code ANSI/NFPA 70, local building codes, and the requirements of the authority having jurisdiction.

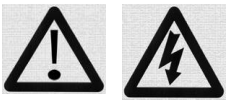


WARNING: These servicing instructions are for use by qualified personnel only. To reduce the risk of electric shock, do not perform any servicing other than that specified in the operating instructions unless you are qualified to do so.

WARNING: Before installing or using the recombiner, read all of the instructions and warnings on the recombiner and in this *Installation Guide*.



WARNING: PV arrays produce electrical energy when exposed to light and thus create an electrical shock hazard.



WARNING: With Disconnecting Recombiners (RC-L, RC-N, RC-C, DE-L, DE-N and CE-C) both the line and load side of the disconnect may still be energized in the OFF position. Always test both sides of the disconnect before servicing the disconnect recombiner.

WARNING: Never remove a fuse holder while it is under load. Electrical arcing and damage to the fuse and fuse holder will occur if a fuse holder is opened under load.

2.0 Introduction

SolarBOS has introduced a new line of PV recombiners designed for use with all module and inverter combinations.

Recombiner features include:

- Listed to UL 1741
- Simplified input and output wiring
- Available in NEMA 3, 3R, 4 powder-coated steel, and NEMA 4X stainless steel enclosures.
- Integrated load-break contactors (optional).
- Integrated load-break disconnect(s) (optional).
- Integrated non-load-break disconnects (optional).
- Current and Voltage monitoring data collection and output using Modbus protocol (optional).
- Ground fault detection interruption (optional)
- Transient surge suppression (optional)

2.1 Part Number Guide

All SolarBOS recombiners use the same part numbering system. An example part number could be RCKT-08-200MN-N3 which correlates to; a recombiner, 1000vdc, surge suppression, 8 circuits, 200A, monitoring, non-load break, Nema 3 enclosure. The following table displays all characters used in Recombiner part numbers. Each column designates a section of the part number.

Table 1A. Part Number Characters (in proper order)

Type	Option	# Circuits	Ampacicty	Option	Enclosure
RC	K	2-16	70-100	M	N3
FB	G		110-200	C	N4
DE	T		225-400	L	N4XSS
CE				N	

Table 1B. Part Number Character Key

RC	Recombiner
FB	Fuse Box
DE	Disconnect Enclosure
CE	Contactor Enclosure
K	1000VDC
G	Ground Fault Interruption
T	Transient Surge Suppression
M	Current Monitoring (Voltage optional)
C	Contactor
L	Load Break Disconnect
N	Non-Load Break Disconnect

2.2 Unpacking and Inspection

All SolarBOS recombiners are thoroughly checked before they are packaged and shipped. Although they are shipped in sturdy packaging, damage can still occur during shipping and delivery. It is important to carefully inspect the shipping container and contents prior to installation. If you detect any external damage after unpacking, report the damage immediately to SolarBOS and the shipping company that delivered the unit. Items not rejected within 10 days of delivery are considered accepted without recourse. If it becomes necessary to return the recombiner, please use the original packing material.

If you need assistance in dealing with a damaged unit, contact SolarBOS at 925-456-7744.

3.0 Installation

SolarBOS recommends using 5/16" steel bolts to mount the recombiners to steel racking or a concrete wall. Alternately, floor mount kits are available. Weights of each of the recombiners are listed in Tables 2 and the dimensions of the mounting locations are provided in Figure 1 and Table 3 (pg. 9)

3.1 Dimensions and Weights

Refer to Table 2 for enclosure dimensions and weights. Dimension and weight is provided in the form H"xW"xD" (lb). Refer to Figure 1 and Table 3 (pg. 8) for mounting Dimensions.

Table 2A. Standard Recombiner Dimensions and Weights 70-100A

		H"xW"xD" (lb)							
		RC	RC-N	RC-L	RC-C	FB	FB-N / DE-N	FB-L / DE-L	FB-C / CE-C
# Circuits	2	30x30x12 (149)	------	36x36x8 (158)	36x36x8 (152)	24x24x6 (63)	------	30x30x8 (110)	30x30x8 (101)
	3	30x30x12 (150)	36x36x8 (144)	42x36x8 (184)	36x36x8 (154)	24x24x6 (63)	30x30x8 (104)	36x36x8 (154)	30x30x8 (103)
	4	30x30x12 (150)	36x36x8 (146)	48x36x8 (212)	36x36x8 (156)	24x24x6 (64)	30x30x8 (106)	42x36x8 (180)	30x30x8 (204)
	5	30x30x12 (151)	------	60x36x10 (274)	42x36x8 (178)	24x24x6 (64)	------	48x36x8 (207)	30x30x8 (106)
	6	30x30x12 (151)	42x36x8 (170)	60x36x10 (280)	42x36x8 (180)	24x24x6 (64)	30x30x8 (110)	60x36x10 (263)	30x30x8 (107)
	7	30x30x12 (152)	------	72x36x12 (341)	42x36x8 (182)	24x24x6 (64)	------	72x36x12 (321)	36x36x8 (147)
	8	30x30x12 (152)	48x36x8 (195)	72x36x12 (347)	48x36x8 (205)	30x30x8 (101)	30x30x8 (112)	72x36x12 (327)	36x36x8 (148)
	9	30x30x12 (153)	48x36x8 (195)	------	48x36x8 (207)	30x30x8 (101)	36x36x8 (148)	------	42x36x8 (170)
	10	30x30x12 (153)	------	------	48x36x8 (209)	30x30x8 (101)	------	------	42x36x8 (171)
	11	36x36x8 (150)	------	------	60x36x10 (261)	36x36x8 (140)	------	------	48x36x8 (194)
	12	36x36x8 (150)	60x36x10 (249)	------	60x36x10 (263)	36x36x8 (140)	42x36x8 (170)	------	48x36x8 (195)
	13	36x36x8 (151)	------	------	60x36x10 (265)	36x36x8 (141)	------	------	60x36x10 (247)
	14	42x36x8 (171)	------	------	72x36x12 (316)	42x36x8 (161)	------	------	60x36x10 (248)
	15	42x36x8 (172)	------	------	72x36x12 (318)	42x36x8 (162)	------	------	60x36x10 (250)
	16	42x36x8 (172)	60x36x10 (259)	------	72x36x12 (322)	42x36x8 (162)	48x36x8 (199)	------	60x36x10 (252)

Table 2B. Standard Recombiner Dimensions and Weights 110-200A

# Circuits	H"xW"xD" (lb)							
	RC	RC-N	RC-L	RC-C	FB	FB-N / DE-N	FB-L / DE-L	FB-C / CE-C
2	36x36x8 (148)	------	36x36x8 (155)	36x36x8 (170)	24x24x6 (64)	------	30x30x8 (111)	30x30x8 (102)
3	36x36x8 (149)	36x36x8 (164)	42x36x8 (180)	36x36x8 (1372	24x24x6 (64)	30x30x8 (104)	36x36x8 (155)	30x30x8 (104)
4	36x36x8 (150)	36x36x8 (168)	48x36x8 (220)	36x36x8 (174)	24x24x6 (64)	30x30x8 (106)	42x36x8 (181)	30x30x8 (106)
5	36x36x8 (151)	------	60x36x10 (280)	42x36x8 (196)	24x24x6 (65)	------	48x36x8 (208)	30x30x8 (108)
6	36x36x8 (152)	42x36x8 (192)	60x36x10 (288)	42x36x8 (198)	24x24x6 (65)	30x30x8 (110)	60x36x10 (264)	30x30x8 (110)
7	36x36x8 (153)	------	72x36x12 (350)	42x36x8 (200)	30x30x8 (103)	------	72x36x12 (322)	36x36x8 (150)
8	36x36x8 (154)	48x36x8 (216)	72x36x12 (358)	48x36x8 (223)	30x30x8 (103)	30x30x8 (112)	72x36x12 (328)	36x36x8 (152)
9	36x36x8 (155)	48x36x8 (219)	------	48x36x8 (225)	36x36x8 (140)	36x36x8 (148)	------	42x36x8 (174)
10	36x36x8 (156)	------	------	48x36x8 (227)	36x36x8 (140)	------	------	42x36x8 (176)
11	42x36x8 (177)	------	------	60x36x10 (279)	36x36x8 (141)	------	------	48x36x8 (199)
12	42x36x8 (178)	60x36x10 (275)	------	60x36x10 (281)	42x36x8 (163)	42x36x8 (170)	------	48x36x8 (201)
13	42x36x8 (179)	------	------	60x36x10 (283)	42x36x8 (163)	------	------	60x36x10 (253)
14	48x36x8 (201)	------	------	72x36x12 (337)	48x36x8 (163)	------	------	60x36x10 (255)
15	48x36x8 (202)	------	------	72x36x12 (339)	48x36x8 (183)	------	------	60x36x10 (257)
16	48x36x8 (203)	60x36x10 (282)	------	72x36x12 (341)	48x36x8 (183)	48x36x8 (199)	------	60x36x10 (259)

Table 2C. Standard Recombiner Dimensions and Weights 225-400A

# Circuits	H"xW"xD" (lb)							
	RC	RC-N	RC-L	RC-C	FB	FB-N / DE-N	FB-L / DE-L	FB-C / CE-C
2	36x36x8 (170)	------	48x48x12 (235)	36x36x8 (157)	36x36x8 (140)	------	36x36x8 (156)	36x36x8 (142)
3	36x36x8 (171)	36x36x8 (200)	60x48x12 (508)	36x36x8 (161)	36x36x8 (142)	36x36x8 (146)	42x36x8 (186)	36x36x8 (145)
4	36x36x8 (172)	36x36x8 (205)	60x48x12 (523)	36x36x8 (165)	36x36x8 (144)	36x36x8 (148)	48x36x8 (217)	36x36x8 (148)
5	36x36x8 (173)	------	72x36x12 (380)	42x36x8 (189)	36x36x8 (146)	------	60x36x10 (277)	36x36x8 (151)
6	36x36x8 (174)	48x48x12 (245)	72x36x12 (388)	42x36x8 (193)	36x36x8 (148)	36x36x8 (156)	72x36x12 (339)	36x36x8 (154)
7	36x36x8 (175)	------	------	42x36x8 (197)	36x36x8 (150)	------	------	36x36x8 (157)
8	42x36x8 (196)	48x48x12 (255)	------	48x36x8 (222)	36x36x8 (152)	36x36x8 (160)	------	36x36x8 (160)
9	42x36x8 (197)	48x48x12 (260)	------	48x36x8 (226)	42x36x8 (174)	42x36x8 (188)	------	42x36x8 (183)
10	48x36x8 (219)	------	------	48x36x8 (230)	42x36x8 (176)	------	------	42x36x8 (186)
11	48x36x8 (220)	------	------	60x36x10 (284)	48x36x8 (199)	------	------	48x36x8 (210)
12	48x36x8 (221)	60x48x12 (528)	------	60x36x10 (288)	48x36x8 (201)	48x36x8 (217)	------	48x36x8 (213)
13	------	------	------	------	60x36x10 (253)	------	------	60x36x10 (266)
14	------	------	------	------	60x36x10 (255)	------	------	60x36x10 (269)
15	------	------	------	------	60x36x10 (257)	------	------	60x36x10 (272)
16	------	------	------	------	60x36x10 (259)	60x36x10 (270)	------	60x36x10 (275)

Figure 1. Recombiner Enclosure Dimensions (not to scale)

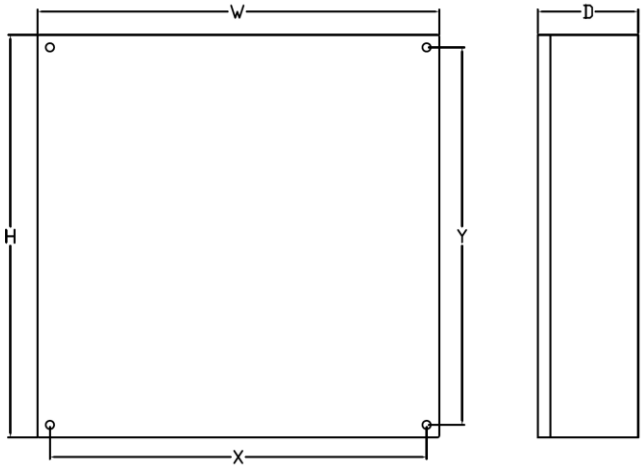


Table 3. Recombiner Mounting Dimensions

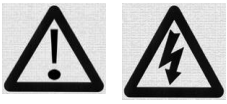
Enclosure Mounting Dimensions		
H"xW"xD"	X"	Y"
24x24x6	22.5	22.5
30x30x8	28.5	28.5
36x36x8	34.5	34.5
42x36x8	34.5	40.5
48x36x8	34.5	46.5
60x36x10	34.5	58.5
72x36x12	34.5	70.5

3.2 Recombiner Orientation

Recombiners may only be installed in the vertical orientation. This applies to all variations of the recombiner units.

3.3 Touch Safe Guard

Recombiners ship with a fuse guard(s) protecting the live components from accidental contact. For installation of the recombiner, the touch safe guard(s) will need to be removed by unfastening the screws securing the guard to the standoffs. Then remove the guard to install the input wire leads. Once the input wiring is complete, refasten the guard to the standoffs using the mounting screws.



WARNING: The touch safe guard must be installed prior to placing the recombiner under load.

4.0 Wiring

Maximum input/output voltage and maximum input/output current for each unit is listed on the interior and exterior label of each unit. All units are rated for 50C ambient temperature.

For units installed in Canada the wiring methods used shall be in accordance with the Canadian Electrical Code, Part 1.

NOTE: The recombiner enclosure is shipped with no entry holes. A knock-out is required for the appropriate conduit size. SolarBOS recommends wire entry be made according to Figure 2 and Table 4 (pg. 11).

NOTE: Rain tight or wet location hubs that comply with the Standard UL514B must be used for NEMA 3/3R outdoor applications. NEMA 4 or 4X applications must use watertight hubs that comply with the Standard UL514B. Use Myers-type, water-tight conduit fittings such as Thomas & Betts H200TB (for 2" conduit) or H300TB (for 3" conduit) or equivalent from others. Install fittings per manufacturer's recommendations.

4.1 Input Wiring

Refer to Figure 2 and Table 4 (pg. 12) for the input wiring locations of the recombiner. PV positive and negative conductors are wired into the positive lug and negative distribution block, respectively. These terminal locations are clearly marked. All PV safety ground conductors are wired into the ground bus located at the bottom of the recombiner box.

4.2 Output Wiring

Many of our recombiners have large fault current ratings.

When temperature and voltage drop adjustments are considered, the output conductor sizes can become quite large (500 MCM or greater) and difficult to manage. NEC Article 310.4 allows paralleling of conductors greater than AWG 1/0 to achieve higher ampacities.

Most SolarBOS recombiners provide output terminals for paralleling two conductors for the PV positive and negative, as well as the equipment ground conductors. Refer to Figure 2 and Table 4 (pg. 12) for the output wiring locations.

4.3 Wire Entry Locations & Dimensions

The following locations are recommendations only. Care should always be taken to assure there is enough wire bend space for the desired output wire gauge when choosing a conduit entry location. Actual dimensions may vary.

Product types are listed using short notation such as RC-N. An example of a part number for RC-N may appear as RC-08-200N-N3. See “Part Number Guide” (pg. 6) for complete explanation of part numbers.

Pertinent part number characters:
N indicates non-load break
L indicates load break
C indicates contactor

Note: Dimension “E” is equal to zero (0) for all monitoring, surge arrestor and GFDI models.

Figure 2A. Recombiner type (RC, RC-N, RC-L, RC-C) Wire Entry Locations (not to scale)

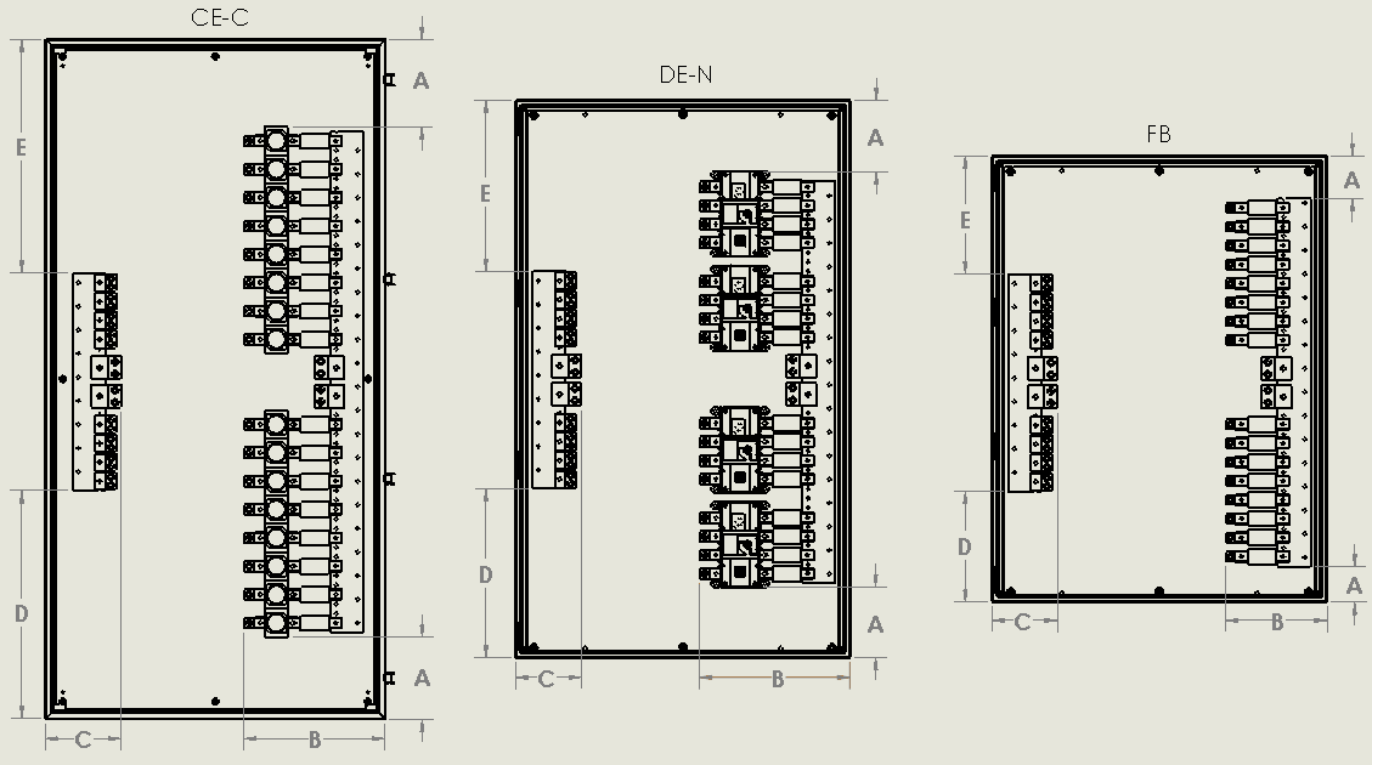


Table 4A. Wire Entry Dimensions for Recombiner type

			A	B	C	D	E
Recombiner Type	70-100A	RC	4 min.	8	4	12	12
		RC-N	4 min.	14	4	12	12
		RC-L	4 min.	14	4	12	12
		RC-C	4 min.	12.5	4	12	12
	110-200A	RC	4 min.	10	6	10	10
		RC-N	4 min.	16	6	10	10
		RC-L	4 min.	16	6	10	10
		RC-C	4 min.	15.5	6	10	10
	225-400A	RC	4 min.	11	6	8	8
		RC-N	4 min.	20	6	8	8
		RC-L	4 min.	20	6	8	8
		RC-C	4 min.	16.5	6	8	8

Figure 2B. Non-Recombiner type (FB, DE-N, DE-L, CE-C) Wire Entry Locations (not to scale)

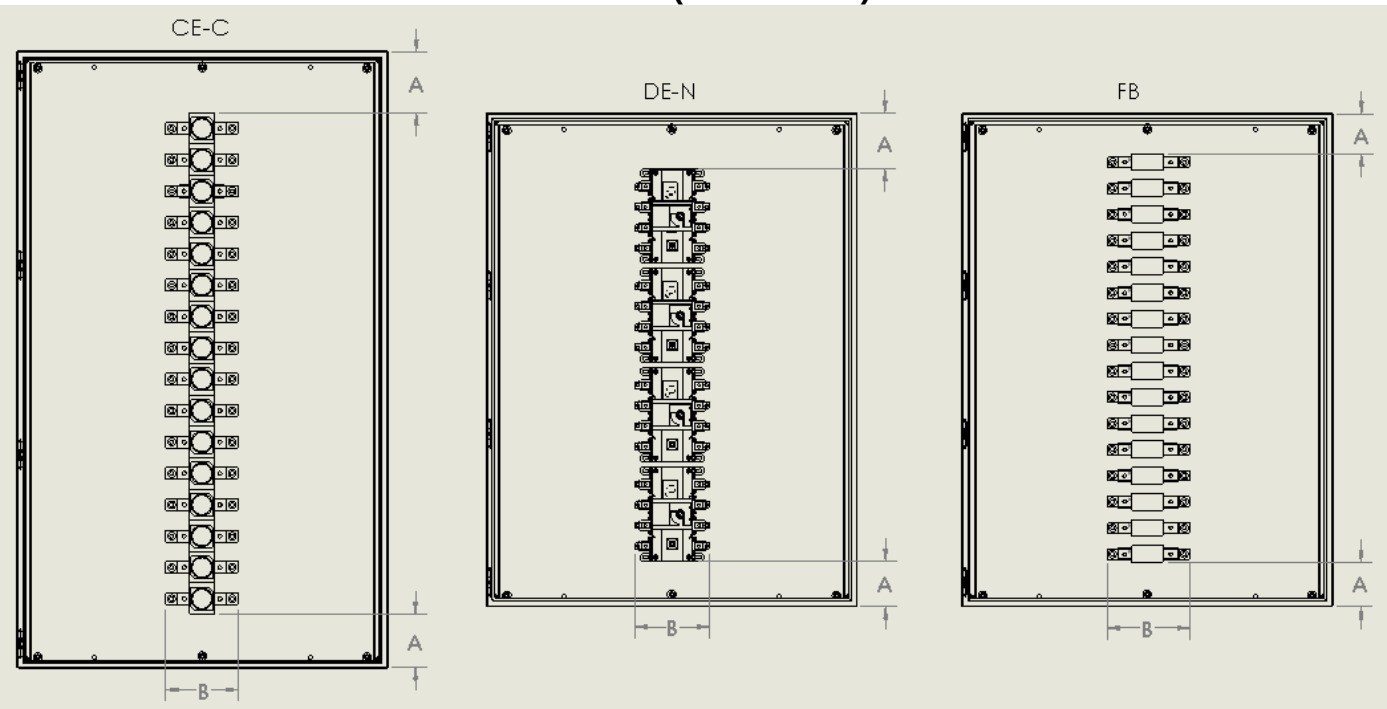


Table 4B. Wire Entry Dimensions for Non-Recombiner type

			A	B
Non-Recombiner Type	70-100A	FB	4 min.	6
		FB-N	4 min.	11
		DE-N	4 min.	7.25
		FB-L	4 min.	11.5
		DE-L	4 min.	8.25
		FB-C	4 min.	9.5
		CE-C	4 min.	5.5
	110-200A	FB	4 min.	8
		FB-N	4 min.	13
		DE-N	4 min.	7.5
		FB-L	4 min.	13.5
		DE-L	4 min.	8.75
		FB-C	4 min.	11.5
		CE-C	4 min.	7
	225-400A	FB	4 min.	10
		FB-N	4 min.	18
		DE-N	4 min.	12.75
		FB-L	4 min.	18
		DE-L	4 min.	12.5
		FB-C	4 min.	12.5
		CE-C	4 min.	7.5

4.4 Torque Values for Wire Landings

When wiring the recombiner, use the torque values listed in Table 5.

Table 5. Wire Torque Values

350 AND LARGER BOX LUGS	
CONDUCTOR SIZE	**TORQUE**
1/0 - 2/0	180 in-lbs
3/0 - 4/0	250 in-lbs
250 - 350	325 in-lbs
400 - 600	375 in-lbs
700 - 800	500 in-lbs
900 - 1000	600 in-lbs

2/0 BOX LUGS		
CONDUCTOR SIZE		**TORQUE**
1/0 - 2/0		120 in-lbs
BOLTED CONNECTIONS & COMPRESSION LUGS		
THREAD	**SOCKET**	**TORQUE**
M6*	Allen	160 in-lbs
M8	13mm	220 in-lbs
M8*	Allen	250 in-lbs
M10	17mm	550 in-lbs
M12	19mm	600 in-lbs
SMALL CONDUCTORS		
ITEM		**TORQUE**
FUSEHOLDER/SURGE (TVSS)		22 in-lbs

*For Circuit Breakers

5.0 PV Fuses

All SolarBOS recombiners ship with fuses installed according to the user's predetermined requirements. All fuses and connection points are electrically tested prior to shipment. SolarBOS maintains stock of common fuse sizes if replacements are necessary or spares desired.

For units installed in Canada without integral fuses shall not be connected to a battery or can be connected to a battery if the overcurrent protection meeting the listed current on the recombiner label and of photovoltaic type be installed at the battery, as part of the installation, in accordance with the Canadian Electrical Code, Part 1.

6.0 Current Monitoring Recombiner Option

6.1 Power Supply

One 30W power supply is used to supply DC power to all electrical subcomponents in the current monitoring recombiner, including the current transducers and I/O module. The DC power supply requires 100-240VAC input.
See IDEC Instruction Sheet for additional information on the power supply unit.

6.2 Current Transducers

Each circuit of the current monitoring recombiner has a DC Current Transducer that is utilized to monitor the DC current for data acquisition. The DC Current Transducer comes pre-wired with the I/O Module and power supply. Power for each current transducer is provided by the DC power supply.
See the Veris Industries Installation Guide for additional information on the current transducers.

6.3 Voltage Transducer

The voltage transducer comes pre-wired on Re-combiner models. On DE, CE and FB boxes the negative voltage tap must be connected by the installer. The output of the Transducer is 4-20ma however 0-5V units are available upon request.

6.3 I/O Module

The monitoring recombiner utilizes an I/O Module to transmit the DC Current Transducer data along an RS-485 network using Modbus protocol. This allows the module to forward the data to the host computer in engineering units (mA). Each current monitoring recombiner comes with either an Adam 4017+ I/O Module or an Obvius Flex I/O Module.

6.3.1 ADAM 4017+

The ADAM 4017+ I/O Module comes with the Modbus device address set to 001 and a Baud rate of 9600 Bit/sec, unless otherwise noted on the unit.

To change the settings of the ADAM 4017+:
The ADAM 4017+ has an INIT switch which can be set to “Init” or “Normal” (see Figure 3); setting the switch to “Init” sets the unit in the INIT* state.

INIT* state defaults:
Baud rate: 9600 bps
Address: 00h

Checksum: disabled

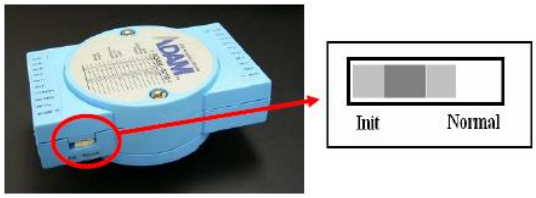


Figure 3. Adam 4017+ I/O Module

Forcing the ADAM 4017+ in INIT* state does not change any parameters in the module. When the ADAM 4017+ is in the INIT* state, all configuration settings can be changed, and the ADAM 4017+ will respond to all other commands normally.

The input range for the ADAM 4017+ is pre-set to 4-20mA to receive signal from DC current transducers. 24VDC Power for the ADAM 4017+ is provided by the DC power supply. Contact Solarbos for Advantech ADAM unit User Manual for additional information.

6.3.2 Obvius Flex I/O A8332-8F2D

Before the Obvius Flex I/O Module can be used, you must set the Modbus address. This address must be unique among all Modbus devices in the system. The Obvius Flex I/O supports address 1 through 127. The sum of the value of the switches is the address; example: 4+16+32=52 (see Figure 4).The Baud rate must also be set to either 19200 Bit/sec or 9600 Bit/sec (see Figure 5).

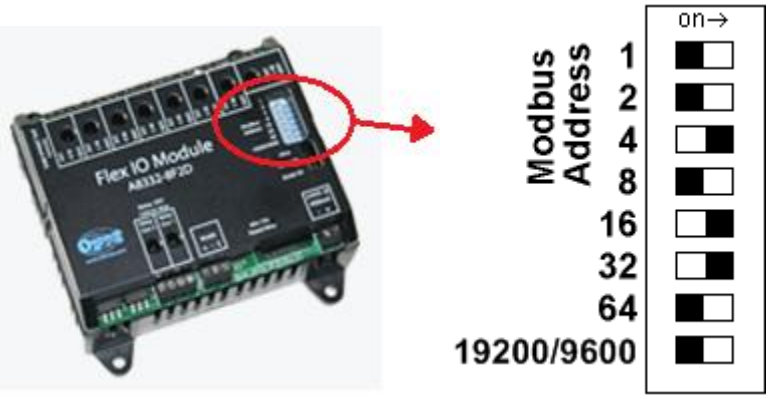


Figure 4. Obvius Flex I/O Module

For each input, you MUST configure the input mode register. [40065 – 40072]. The mode register sets up the input for 4-20mA, 0-10V, pulse, or resistance type sensors. Refer to “A8332-8F2D Modbus Flex I/O Module Installation and Operation Manual” on how to configure the inputs.

6.4 Monitoring System Wiring

6.4.1 Power Supply Wiring

The 30W DC power supply requires 100-240VAC input. These input connects should be made as labeled “L1”, “N”, “G” (see Figure 4).

6.4.2 I/O Module Wiring

The I/O Module should be connected to the RS-485 network using the two connections labeled “Data+” and “Data-“ (see Figure 4).

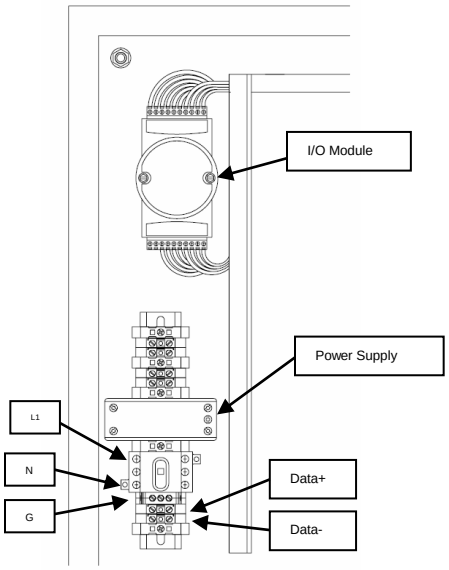


Figure 5. Monitoring System Connections

7.0 Transient Surge Suppressor Option

7.1 Installation

Surge suppressor units are pre-wired by Solarbos. Surge units in grounded systems are wired to the non-grounded bus/circuit and the ground block. Surge units in floating systems are wired to both bus's/circuits (positive and negative) as well as the ground block. Recombiners with multiple non-combined circuits require one surge suppressor per circuit.

7.2 Replacement

Replacement protection modules are available from Solarbos. The whole unit does not need to be removed to replace a protection module. The module unclips from the base unit and is replaced individually.

8.0 Ground Fault detection Interruption (GFDI)

8.1 Installation

Ground fault detection interruption uses a highly accurate differential current transformer and controller. The Bender GFI part number RCMA423-D-1 and W60AB is installed and wired by Solarbos. To work properly the output conductors (both positive and negative) must be run through the aperture of the current transducer (see figure 6). The Ground wire must not pass through the current transducer.

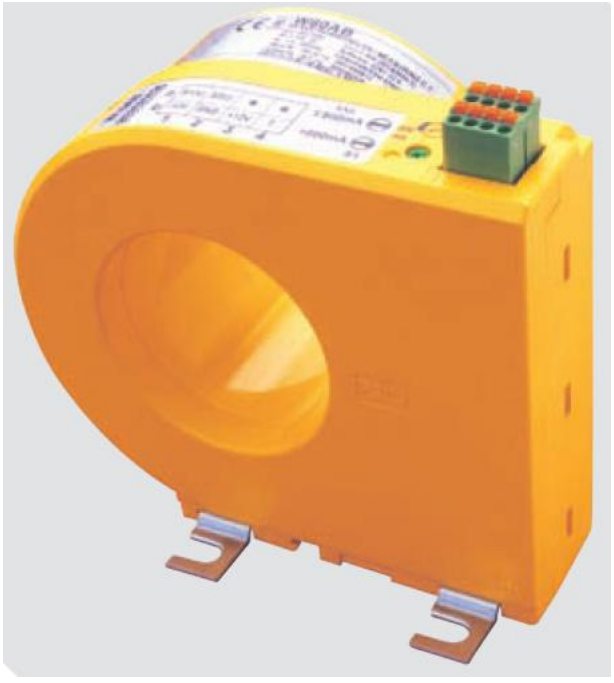


Figure 6. GFDI Current Transducer

8.2 GFDI Features

8.2.1 Detection

The GFDI unit is capable of both detection and interruption. The controller unit displays the instantaneous value of ground fault current and once alarmed will remain so until reset. With the addition of an I/O module and monitoring system the ground fault current value can be monitored remotely. With the use of a Flex I/O the GFDI alarm can be reset manually.

8.2.2 Interruption

Recombiners outfitted with contactors have the added feature of interrupting the system if a ground fault is detected. If the fault current exceeds the set point a relay in the control module cuts power to the contactors turning the system off.

8.3 GFDI Controller

Figure 6. GFDI Control Unit

The controller must be set up before use. This consists of setting the alarm set points. There are two alarms, one pre-alarm and the alarm. The Response delay can also be set. These parameters are unique to the system they are used on and vary according to system size, type of panel and other conditions. See GFDI operating manual for GFDI controller set-up.